The Dynamics of the South China Sea Warm Current (SCSWC)

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LONG-TERM GOALS

The western boundary region of the North Pacific Ocean is unique in that it is porous. Massive exchanges between the Pacific and the marginal seas occur through gaps in the island chain that bounds the open basin. The long-term goal of the work is to understand the dynamics of these exchanges and their consequences in terms of ocean variability.

OBJECTIVES

The dynamics of mesoscale flow features that arise from the disruption of the Kuroshio and its branches by the continental margin topography is the focus of the research. The purpose is to seek an in-depth understanding of the dynamics and ramifications of these features.

APPROACH

The examination and interpretation of current-meter, hydrographic, and remote-sensing data have continued. In addition, the output of the eddy-resolving, general circulation model of the Asian marginal seas developed in part in an earlier project is analyzed to expose the dynamic of the circulation concerning the Kuroshio/topography interaction. Isolatable dynamic issues are addressed with analytical models and a two-layered Miami Isopycnic Coordinate Ocean Model (MICOM).

RESULTS

(1). The collision with the continental margin off the southern coast of China of Kuroshio (anti-cyclonic) current rings forces leakage of Kuroshio water from the ring, giving rise to a western boundary current (South China Sea Branch of Kuroshio)(SCSBK) to the southwest along the upper slope. The dynamics is similar to Nof (1999) except that the sloping bottom hastens the leakage process and strengthens the leakage flow.

(2). The interception of a cyclonic open-ocean eddy by a western continental slope generates a current to the northeast, similar to the observed sporadic current off southeast Ryukyu Islands, known as the East Ryukyu Current. The time scale (~100 days) of the current appears to match that found in the Sea-Surface Height Anomaly field derived from the TOPEX/Poseidon altimeter data. Fig. 1 shows the simulation of the interception of a cyclonic eddy by a western continental slope with a two-layered MICOM. The upper layer thickness decreases linearly toward the coast from 1000m at 200 km off the

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coast. The northeastward current is generated north of the eddy as the shoaling of the upper layer creates anti-cyclonic vorticity. This is similar to the barotropic phenomenon discussed in Zavala Sanson and van Heijst (2000).

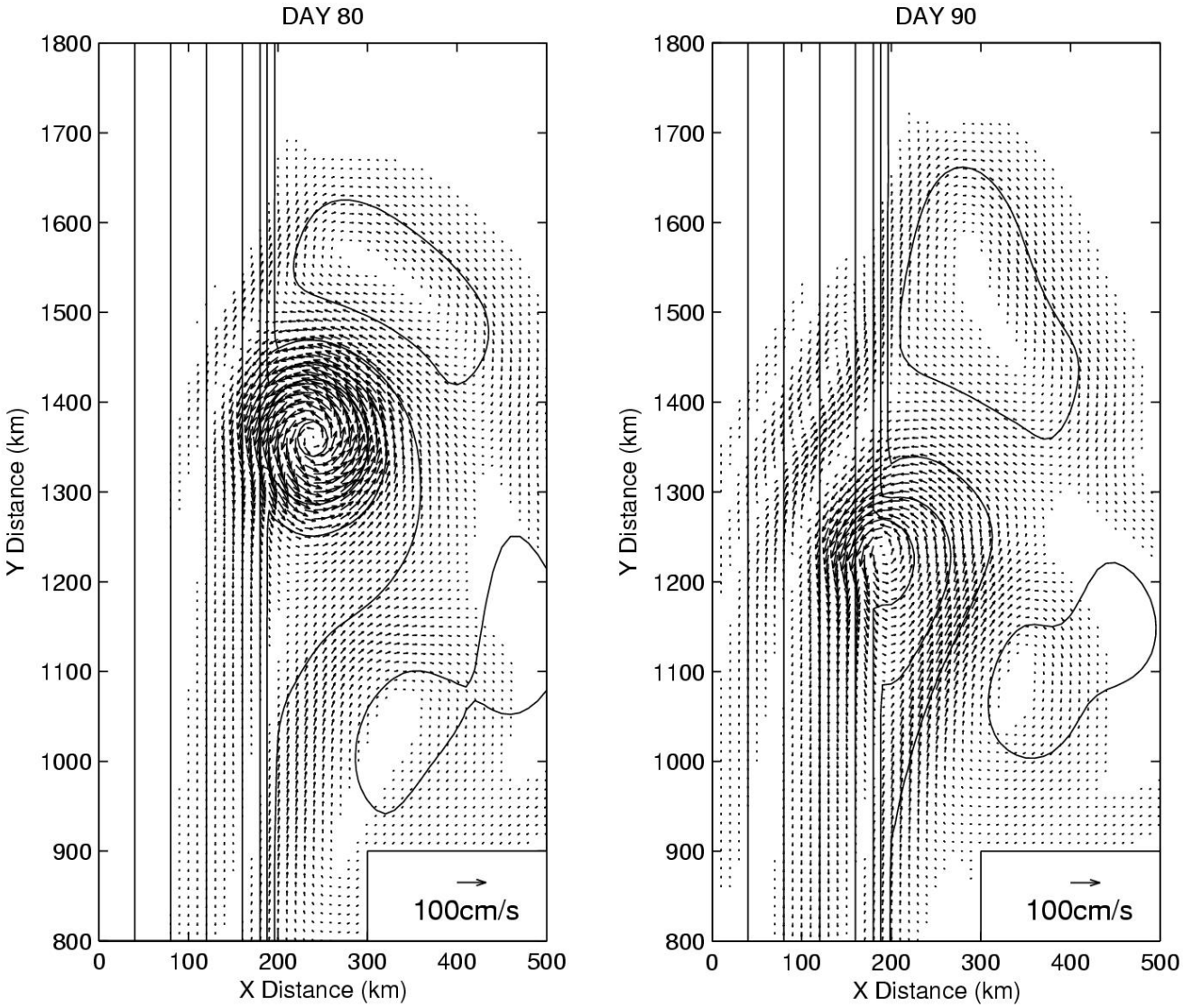

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Fig. 1. Upper layer thickness contours (200, 400, 600, 800, 900, 940,980,1020m from the coast on the left) and velocity vectors surrounding a cyclonic Gaussian eddy in a MICOM ocean with a sloping western boundary. The eddy has drifted over the slope and begun to break up. A northeastward current over the slope develops as the eddy undergoes water column fore-shortening which generates anti-cyclonic vorticity. Left and right panels show the snapshots at Day 80 and 90, respectively, of the integration.

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IMPACT/APPLICATIONS

The anti-cyclonic Kuroshio current-ring leakage along the upper continental slope provides a basis for the explanation of a time-dependent western boundary current that is responsible for heightened mesoscale variability along the northwest margin of the South China Sea (Wang et al., 2000). The

generation of anti-cyclonic vorticity as a cyclonic eddy breaks up over a western continental slope leads to the creation of a northeastward current that is similar to the observed East Ryukyu Current.

TRANSITIONS

The work has provided the theoretical basis for a future joint current meter mooring experiment off the southeast Ryukyu Islands with Dr. Hiroshi Ichikawa of the Japan Marine Science and Technology Center (JAMSTEC).

RELATED PROJECTS

None.

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PUBLICATIONS

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PATENTS

None.